

TITLE

"FUSE ARRANGEMENTS AND FUSE BOXES FOR A VEHICLE"

BACKGROUND OF THE INVENTION

5           The present invention relates generally to fuse boxes for vehicle electrical systems. More specifically, the present invention relates to fuse arrangements that can be used in vehicle fuse boxes.

10           Of course, it is known to use fuses in vehicles such as an automobile. Typically, such fuses are located within one or more fuse boxes that are located within the vehicle. The fuse boxes provide a central location for the placement of fuses. Each of the electrical circuits within the vehicle is routed through the fuse box and to  
15 a fuse. This allows the fuses to protect the wiring and the load from harmful overcurrent conditions.

~~Referring to Figure 1, a typical fuse box used in an automobile is illustrated. The fuse box 10 is typically constructed of a rigid plastic and includes a  
20 base 12 and a cover 14. The base 12 includes a number of terminals 16 disposed in a bottom portion 18 of the base. These terminals are electrically connected to fuse receptacles 22 on a top portion 20 of the base.~~

25           Each fuse receptacle 22 contains two "female" apertures 24 that receive corresponding "male" fuse blades 28 of a typical radial-type automotive fuse 26, shown in Figure 2. The particular terminals 16a and 16b connected to a fuse receptacle 22a are, in turn,

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respectively connected to a power source (e.g., B+) and an electrical load 25 within the vehicle. Hence, the power terminal 16a and the load terminal 16b are spaced close together for each circuit routed through the fuse box 10. This close spacing can be disadvantageous due to excess heating that can occur at the terminals. Further, since all of the power and load terminals 16 are closely located to one another in the bottom portion 18 of the fuse box 10, the heating that occurs can become excessive, particularly in newer automobile electrical systems having higher load requirements.

~~Additionally, the standard automobile fuses known in the art (e.g., see Figure 2) are manufactured as singular devices. Fuses shipped to the end user (e.g., an automobile manufacturer) are typically packaged as singulated devices that are delivered in bulk or placed within a "tube", taped together or other similar packaging that is convenient for the end user when inserting the fuses into the above-described fuse boxes, for example. However, such packaging is costly and time intensive for the fuse manufacturer since the fuses must be individually separated and packaged.~~

Furthermore, fuse boxes known in the art (e.g., see Figure 1) are designed to receive individual fuses that must be individually inserted into the fuse box. Because fuses are individually placed in the fuse box, the number of manufacturing steps is increase, thereby also

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lost.

increasing the complexity of placing and connecting the  
fuses in the fuse box when multiple fuses are required,  
for example.

Another issue with fuses boxes is size. As with any  
5 component used in a vehicle, size is increasingly a  
concern. Automobile manufacturers are constantly  
striving to reduce the size and weight of most automobile  
components. Fuse boxes, due to their current structure  
and the arrangement of the fuses and related components,  
10 create some unique issues in attempting to reduce the  
size of same.

Accordingly, there is a need for an improved fuse  
box and fuse arrangement.

#### SUMMARY OF THE INVENTION

15 The present invention provides improved fuse  
arrangements as well as improved fuse boxes.

In an embodiment of the invention, a fuse  
arrangement is provided having a wiring terminal with a  
plurality of discrete circuits extending therefrom. In  
20 addition, the arrangement includes a common bus assembly.  
At least one axial fuse is disposed between the wiring  
terminal and the common bus assembly such that the common  
bus assembly is electrically connected to the wiring  
terminal through the at least one fuse. The placement  
25 of an axial fuse between the common bus assembly  
supplying a voltage and the wiring terminal serves, in  
part, to diminish the heat generated in the arrangement

by allowing heat to more readily dissipate. In addition, the use of common bus assembly decreases the complexity of the fuse arrangement. Moreover, this arrangement allows one to design fuse boxes having a reduced size.

5 ~~In another embodiment of the invention, a fuse array~~  
is constructed with a planar insulating substrate having two planar sides. A metallization pattern is disposed on at least one side of the substrate and comprises at least one fuse element. A protective coating is disposed  
10 on the sides of the substrate and covers at least a first portion of the metallization. The construction of one or more fuses on a planar substrate affords modularity in the fuse design and corresponding easier insertion and removal of fuses within a fuse block.

15 In another embodiment of the invention, a packaging apparatus for vehicle fuses includes a carrier strip having at least one rail comprised of a flexible material. In addition, a plurality of fuse assemblies are integrally connected to the at least one rail, but  
20 also configured to be separable from the rail by an end user. The carrier strip is capable of being rolled to form a package for shipping to the end user. The use of a carrier strip having integral fuse assemblies and the capacity to be rolled-up for shipping reduces  
25 manufacturing steps and costs for the fuse manufacturer. Additionally, since the fuse assemblies are configured to be separable from the rails of the carrier strip by

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$\frac{1}{\sqrt{\pi}} \int_{-\infty}^{\infty} f(x) \delta(x-a) dx = f(a)$

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Other objects and advantages of the invention will become apparent upon reading the following detailed

description and appended claims, and upon reference to the accompanying drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

References made to the attached drawings, wherein  
5 elements having the same reference numeral designations represent like elements throughout and wherein:

Figure 1 is a perspective drawing illustrating a fuse box arrangement known in the art.

Figure 2 is a perspective view of a conventional  
10 radial-type fuse used in the fuse box shown in Figure 1.

Figure 3 is a sectional view of a fuse box arrangement according to an embodiment of the present invention.

Figure 4 is a section diagram illustrating a fuse  
15 box according to an alternative embodiment of the present invention.

Figure 5 is a section drawing of a fuse box according to yet another embodiment of the present invention.

Figure 6 is an illustration of a fuse array  
20 according to an embodiment of the present invention.

Figure 7 is a top section view of the fuse array shown in Figure 6.

Figure 8 is an end section view of the fuse array  
25 illustrated in Figure 6.

Figure 9 is a cut away view of the fuse array shown in Figure 6 illustrating a metallization pattern.

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Figure 10 is an illustration of a fuse packaging arrangement for axial-type fuses according to an embodiment of the present invention.

5 Figure 11 is an illustration of a fuse packaging arrangement for radial-type fuses according to another embodiment of the present invention.

Figure 12 illustrates a small automobile fuse according to an embodiment of the present invention.

10 **DETAILED DESCRIPTION OF THE**  
**PRESENTLY PREFERRED EMBODIMENTS**

The present invention provides improved fuse arrangements and fuses boxes.

15 In part, the present invention provides a fuse box arrangement for a vehicle that diminishes the heat generated by typical fuse boxes that include closely spaced terminals due to both supply and load terminals being located on one side of a fuse box. Additionally, the present invention provides a fuse arrangement that decreases the complexity of assembly of a fuse box and  
20 also the placement and connection of the fuses. Moreover, the present invention provides an arrangement for packaging fuses that facilitates the ease of manufacturing as well as placement and connection of the fuses by an end user. Further, the present invention  
25 provides concepts and arrangements that allow one to design and manufacture fuse boxes having a reduced size.

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~~Referring now to the figures, Figure 3 is a sectional view of an exemplary fuse box arrangement according to the present invention. The fuse box, shown generally at 40, includes a base portion 42 and a cover 44. In the embodiment illustrated, within the base portion 42, is a wiring harness 52 having a plurality of terminals 53 that connect with fuses (i.e., fuses 48<sub>1</sub>-48<sub>n</sub>). The wiring harness 52 is connected to a plurality of conductors 56 that supply current to loads within a vehicle containing the fuse box 40.~~

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~~In the embodiment illustrated, the cover 44 includes an integral common bus terminal 46 that connects with each of the fuses 48 via the fuse terminals 49. The common bus terminal 46 is preferably connected to the positive terminal voltage B+ of the vehicle battery, shown connected at node 54.~~

In the exemplary embodiment, each of the fuses 48 is an axial-type fuse comprised of a fuse body 51 that encloses a fuse element 50. In addition, each of the fuses 48 has a pair of opposing terminals 49 connected to the fuse element 50 that extend outward from the fuse body 51 in opposing directions.

When the fuse box 40 is assembled, a terminal 49 of each of the fuses 48 is inserted into a receptacle 55 within the base 42 that connects to the terminals 53 within the wiring harness 52. Preferably, the receptacles 55 are of a female-type that receive a male-



type terminal 49 of the fuse 48. However, the receptacle 55 can also be constructed as a male-type plug that receives a female-type terminal 49 of the fuse 48.

5 The opposing terminal 49 connected to receptacle 55  
for each fuse 48 is connected to the common terminal bus  
46 having similar receptacles (not shown) to those  
receptacles 55 in the base 42. Since the common bus  
terminal 46 is integral with the cover 44 of the fuse box  
40, connection of the common bus terminal 46 is made with  
10 the terminals 49 of each of the fuses 48 when the cover  
44 is placed on or mated with the base 42. To accomplish  
this connection, the location of the common bus terminal  
46 within the cover 44 is placed such that it is directly  
vertical above the receptacles 55 within the base 42 when  
15 the cover 44 is mated with the base 42.

It will be appreciated that the singular common bus  
terminal 46 enables ease of connection of the voltage B+  
to a group or all of the fuses 48 within the fuse box 40.  
Additionally, this arrangement affords quick connection  
20 or disconnection of the fuses from the battery voltage  
B+. Moreover, the arrangement of the present embodiment  
creates separation of the voltage supply terminal (i.e.,  
the common bus terminal 46) from the terminals 53 that  
supply the loads within the vehicle. Thus, the heat  
25 generated at the terminals 49 of the fuses when current  
flows through the fuses 48 is more easily and efficiently  
dissipated since the two opposing terminals 49 are spaced

apart. This efficient heat dissipation allows the fuse box 40 to more easily be adapted for higher voltages and currents that may be utilized in the vehicle.

In an alternate embodiment, a fuse box 60 shown in  
5 Figure 4 illustrates a common bus terminal 62 that is  
separate from the cover 44 of the fuse box 60. Thus, the  
common bus terminal 62 of the present embodiment can be  
used to connect either all of the fuses 48 within the  
fuse box or a portion of the fuses 48 with the battery  
10 voltage B+. An advantage of this arrangement is that the  
fuses are not disconnected from the supply voltage B+  
when the cover 44 of the fuse box 60 is removed from the  
base 42. A further advantage is that separate common bus  
terminals can be provided for select groups of fuses 48.  
15 Thus, more than one common bus terminal may be provided  
within the fuse box 60.

Figure 5 illustrates yet another alternate  
embodiment of the present invention wherein the wiring  
harness 52 is located within the cover 44 of a fuse box,  
20 shown generally at 70. In this embodiment, the wiring  
harness 52 may either be attached to the cover 44,  
similar to the common bus terminal 46 shown in Figure 3  
or separate from the cover 44, similar to the common bus  
terminal 62 in the embodiment of Figure 4. The fuse box  
25 70 of Figure 5 also includes a common bus terminal 72  
within the base portion 42 of the fuse box that is, in  
turn, connected to the battery supply voltage B+.

As discussed above with respect to Figure 3, the separation of the common bus terminal supplying voltage B+ and the wiring harness 52 affords improved thermal dissipation for a vehicle fuse box. Moreover, as will  
5 be apparent, such a construction may allow one to design and provide fuse boxes for vehicles having a reduced size.

To further improve the thermal properties of the fuse box, in each of the embodiments of Figures 3 through  
10 5, the fuse box housing may be constructed of a thermally conductive material that further facilitates removal of heat from the fuses and other wiring and devices contained within the fuse box. In an embodiment, the fuse box may include, in its interior, thermally  
15 conductive materials to facilitate the diffusion of heat that is generated.

Figure 6 illustrates another embodiment of the present invention for positioning fuses on a rigid substrate. In particular, Figure 6 illustrates a fuse  
20 array 80, preferably for use in a vehicle. The array includes an insulative substrate 92 constructed of ceramic, plastic or some other similar rigid insulator. Preferably, the substrate 92 is a thin elongate rectangle having two planar sides 83 as shown in an end view of the  
25 fuse array in Figure 8.

Disposed on both sides of the substrate 92 is a metallization pattern 88 that is formed to construct the

fuse elements 90. Associated with each fuse element 90 is a contact portion 86 that contacts with fuse block terminals (not shown); the block terminals, in turn, are connected to discreet circuits supplying loads within the vehicle. The metallization pattern 88 also includes a common bus terminal 91 on a portion of the substrate 92 having contact portions 84 that connect to a supply battery voltage B+. Preferably, the patterned fuse elements 90 on one planar side 83 of the substrate 92 are offset from those fuse elements disposed on the other side of the substrate 92. Illustrative of this arrangement, Figure 9 shows a fuse element 90' that is disposed on the side of the substrate opposite to fuse elements 90 and also offset.

Also included in the fuse array are protective coatings 82 disposed on each planar side 83 of the fuse array 80 as shown in Figures 6 through 8. These protective coatings 82 are constructed of an insulative material enabling the fuse array to be held by a user during insertion in or removal from a fuse box.

Of particular note, Figure 9 illustrates that the fuse elements 90 are constructed as axial-type fuses. Such construction enables the common terminal bus 91 to supply voltage on the top portion of the substrate 92. This is advantageous in that, as discussed previously, separation of the load supplying terminals 86 of the fuses from the terminals connected to the voltage supply

terminal (i.e., 91) affords improved heat dissipation properties.

Also of particular note, the substrate 82 covers only a portion of each side 83 of the substrate 92. The portion of the substrate 92 that is not covered forms a contact ledge 85 formed of the exposed metallization pattern (i.e., common bus terminal contacts 84 and fuse element contacts 86) that connect to terminals within a fuse box. Thus, the receiving fuse box (not shown) contains a slot having a number of contacts corresponding to the number of contacts on the fuse array 80, wherein the contact ledge portion 85 fits into the slot within the fuse box. The arrangement may also be advantageous in that a plural number of fuses can be connected and disconnected easily and quickly.

Figure 10 illustrates an embodiment of the present invention for packaging and/or providing to an end user fuses that are used within a vehicle fuse box. Specifically, Figure 10 illustrates a carrier strip 100 that includes a plurality of fuse assemblies 102, each fuse assembly 102 having a housing 104 and a fuse element 106 contained within the housing 104. In the particular embodiment illustrated in Figure 10, the carrier strip 100 includes two parallel rails 110 and 112 that respectively connect with terminals 107 within the fuse assembly 102. The parallel rails 110 and 112 further include indexing holes 108 that index the location of

each particular fuse assembly 102.

When constructed, the carrier strip 100 is integrally connected with each of the fuse assemblies 102. That is, the carrier strip 100, including the fuse assemblies 102, is constructed of one sheet of material preferably copper, zinc or other suitable metal for fuse construction. Furthermore, the carrier strip 100, being constructed from a thin metal sheet made of copper or zinc, has a high degree of flexibility. Thus, the carrier strip 100 including the fuse assemblies 102 is capable of being rolled onto a spool for shipping purposes.

By providing the fuse assembly 102 rolled on a spool, a number of advantages are achieved. One advantage is ease of handling. The end user can merely unroll the carrier strip from the spool and then separate the fuse assemblies 102 from the rails 110 and 112 for use as individual fuses. Preferably, the fuse assemblies 102 are separated from the parallel rails 110 and 112 by cutting the metal at the regions indicated by reference number 109.

The above embodiment has been described with respect to axial-type fuse assemblies. However, as illustrated in Figure 11, the present invention can also be used for radial-type fuses 124 whose terminals 128 are connected to a single rail 120 of a carrier strip assembly.

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~~With both embodiments of Figures 10 and 11, the~~  
carrier strip includes indexing holes 108 and 130 that  
can be further used by the end user to delineate the  
location of the fuse assemblies 102 or 122 when being  
5 separated from the carrier strip rail. For example, in  
an automated separation process that separates the fuse  
assemblies from the rails of the carrier strip, the  
indexing holes 108 or 130 can engage with pegs radially  
projecting from a drive wheel, the pegs spaced an angular  
10 distance around the circumference of the wheel at a  
distance that is equal to a linear distance "d" between  
the indexing holes in the rails of the carrier strip.  
Thus, when the drive wheel has rotated through an angular  
distance equal to "d", a cutting operation can be  
15 performed to separate the fuse assembly from the rails  
~~of the carrier strip.~~

The above described packaging apparatus is  
advantageous in that the fuse manufacturer can assemble  
multiple fuses from a single metal sheet. The fuses can  
20 be easily packaged for shipment to an end user by rolling  
a carrier strip having the multitude of fuses onto a  
spool or other similar device.

Figure 12 illustrates another embodiment of the  
present invention wherein the terminal spacing of small  
25 standard automotive blade fuses is reduced. In  
particular, Figure 12 illustrates a small automotive fuse  
according to the present invention including a housing

142 containing a fuse element (not shown). Extending out of the housing are a pair of blades 140 respectively connected to each side of the fuse element. Typically, in small automotive fuses known in the art, spacing "s" between the center point of the terminal blades 140 is set at an accepted industry standard. However, the spacing "s" is also constrained by the height "h" of the housing assembly.

The present invention includes a small automotive fuse 144 that reduces the spacing "s" between the terminal blades 140. In order to accomplish this reduction in spacing, the height "h" of the fuse housing 142 must be increased to accommodate for a reduction in the width "w" of the housing 142 due to the reduction of the spacing "s". That is, when the spacing "s" is reduced, the width of the housing "w" is reduced in order to have a corresponding reduction in the housing holding the blades 140. Accordingly, since the area within the housing 142 is reduced due to a reduction in the width "w", the height "h" of the housing 142 must be increased in order to regain the original area, which is necessary for the fuse element.

A purpose of the invention shown in Figure 12 is to reduce the spacing "s" between the terminal blades 140 to approximately 5.6 millimeters, for example, so that this fuse may only be inserted into a correspondingly sized fuse receptacle within an automobile fuse box.



Conversely, standard automobile fuses such as that shown in Figure 2, cannot be inserted into the reduced spacing receptacle in the fuse box that accommodates the fuse shown in Figure 12. Accordingly, the circuit connected to the small fuse 144 with reduced terminal spacing can be connected to a circuit having a different voltage supply from the standard 12 volt supply used in most automobile systems.

Especially advantageous is the use of the small fuse 144 with higher voltage systems within a vehicle. Hence, standard 12 volt rated fuses could not be inserted into the fuse box receptacle intended for the higher voltage small fuse 144 having reduced spacing. This thereby acts as a safeguard against improper and dangerous insertion of fuses into receptacles having voltages exceeding their rating.

It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is, therefore, intended that such changes and modifications be covered by the appended claims.